

THE PACIFIC NORTHWEST AQUATIC MONITORING
PARTNERSHIP'S

**Strategy For Coordinating Monitoring of
Aquatic Environments
In The Pacific Northwest**

(Northern California, Oregon, Idaho, Washington)

February 2005

Pacific Northwest Aquatic Monitoring Partnership (PNAMP) Members

Tribal Entities

Columbia River Intertribal Fish Commission
Confederated Tribes of the Colville Reservation
Northwest Indian Fisheries Commission

State Agencies

California Department of Fish and Game
Oregon Watershed Enhancement Board
Washington Interagency Committee for Outdoor Recreation
Washington Department of Ecology
Washington Governor's Salmon Recovery Office

Federal Agencies

Bonneville Power Administration
National Oceanic and Atmospheric Administration Fisheries
U.S. Army Corps of Engineers
U.S. Bureau of Land Management
U.S. Bureau of Reclamation
U.S. Geological Survey
U.S. Environmental Protection Agency
U.S. Forest Service

Regional Entities

Columbia Basin Fish and Wildlife Authority
Northwest Power and Conservation Council
Pacific States Marine Fisheries Commission

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Introduction

Most federal, state, tribal, and private natural resource monitoring programs in the Pacific Northwest have grown in response to different organizational mandates, jurisdictional needs, issues and questions. Consequently, relatively unique independent monitoring efforts that address questions and management problems important to each entity have evolved. However, while some issues are unique to particular agencies, there are many common needs. Where commonalities exist, duplication of effort limits efficiencies and often results in programs that are not cost-effective.

Further, the absence of consistent approaches and protocols in monitoring programs across the region does not cumulatively support broader policy and management objectives and does not result in the collection and presentation of information in a manner that can be easily shared. By coordinating monitoring efforts, the region can more effectively share resources and information and provide increased scientific credibility, cost-effective use of limited funds, and greater accountability to stakeholders.

Realizing this situation, a broad range of state and federal government agencies, tribal organizations, and non-governmental organizations have voluntarily come together to form the Pacific Northwest Aquatic Monitoring Partnership (PNAMP). The purpose of PNAMP is to provide a forum for coordinating state, federal, and tribal aquatic habitat and ESA-listed salmonid monitoring programs. Support for regional coordination of aquatic monitoring comes from the governors of the Northwest states, Congressional oversight of recovery programs, federal Endangered Species Act Biological Opinions relevant to the region, and regional independent scientific review panels. Many agencies from Oregon, Washington, and northern California have signed the PNAMP charter (Appendix A). PNAMP provides leadership through the development and the advancement of recommendations and agency level agreements that are considered for adoption by the participating agencies.

The ad hoc PNAMP partnership developed a draft coordination plan in early 2004: *Recommendations for Coordinating State, Federal, and Tribal Watershed and Salmon Monitoring Programs in the Pacific Northwest* (PNAMP 2004). To further facilitate and advance a coordinated approach to regional monitoring, PNAMP has developed this planning strategy, which identifies PNAMP coordination goals, objectives, and related tasks. The PNAMP strategy document provides a vision for coordination and guides the development of work plans by PNAMP technical working groups. The PNAMP Strategy will be reviewed every two years and changed as significant need justifies.

Goals

The members of the Partnership recognize there are many challenges to successful coordination of monitoring programs. Support of the following goals at the policy level will help participating agencies recognize common program elements and objectives:

- Improve communication among monitoring programs across state, tribal, and federal organizations.
- Improve scientific information needed to inform resource policy and management questions and decisions.

- Seek efficiencies and cost-effectiveness across monitoring programs through compatible and cooperative monitoring efforts.
- Promote science-based credibility of monitoring and assessment efforts.
- Share resources and information among monitoring programs across state, tribal, and federal organizations.

Types of Monitoring Addressed in the Strategy

This Strategy encompasses several types of monitoring at different spatial and temporal scales. We offer definitions here, however, it is important to understand that monitoring types are related, may overlap to some degree, and their naming conventions are not universal.

Implementation Monitoring

The monitoring of management actions to determine if they were implemented properly or comply with established standards. This is normally associated with a restoration project where an engineered solution has been constructed, or where a best management practice (BMP) has been implemented. Implementation monitoring documents the type of action, the location, and whether the action was implemented successfully. It does not require environmental data and is usually a low-cost monitoring activity.

Project Scale Effectiveness Monitoring

Most salmon or watershed projects are implemented at a small scale, with defined sets of actions intended to protect or enhance specific habitat features or habitat-forming processes. Project scale effectiveness monitoring measures environmental parameters to ascertain whether the actions implemented were effective in creating a desired change in habitat conditions.

Validation Monitoring (or Action Effectiveness Research)

This type of monitoring (or research) attempts to establish “cause and effect” or inferential relationships between fish conditions, habitat conditions, and/or management actions. It pertains to evaluation of projects and programs meant to protect or enhance habitat conditions or fish production. These studies are complex and technically rigorous, and often require measuring many parameters under a very structured statistical design to detect the variable affecting change.

Status and Trends Monitoring

The purpose of this type of monitoring is to estimate the status of fish populations and watershed conditions, and to track over time indicators of habitat, water quality, water quantity and other factors that impact watershed health. The spatial scale is large and varies from watershed scale (HUC 6), to ESUs, to the entire Pacific Northwest.

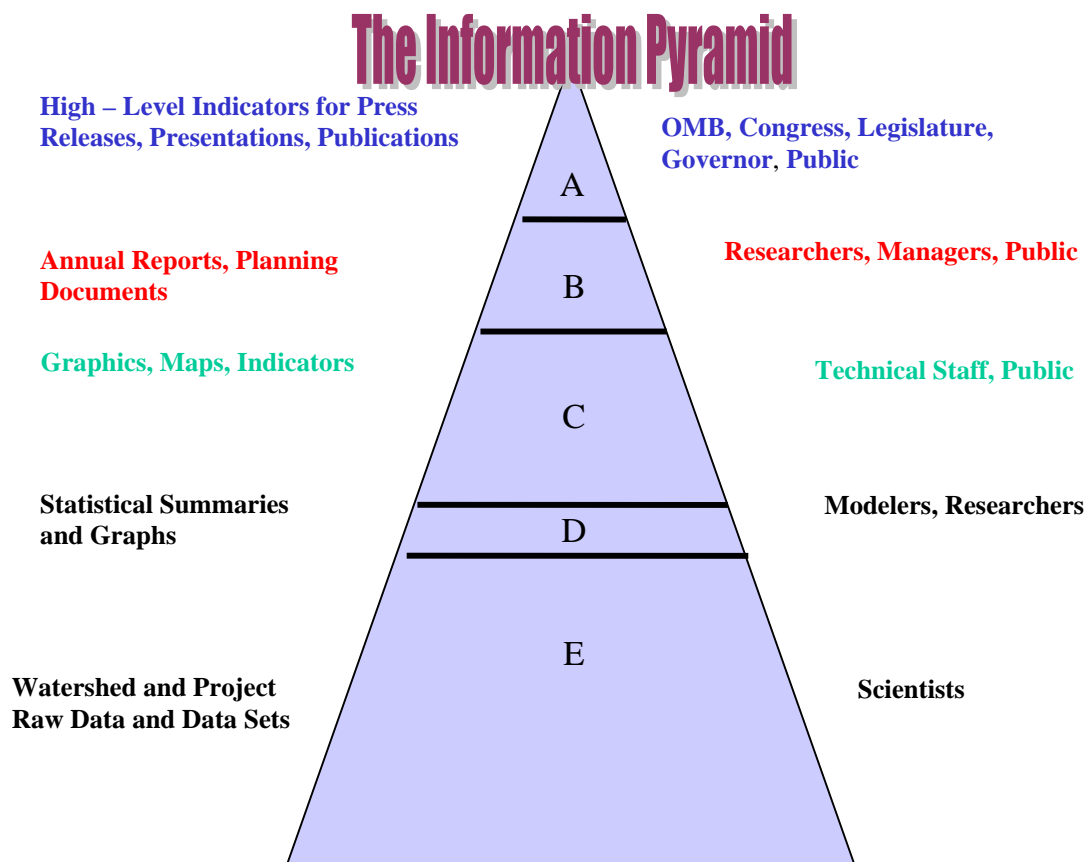
Compliance Monitoring

Compliance monitoring has not been addressed in this Strategy. This type of monitoring typically tracks compliance with established laws, rules, or benchmarks. However, compliance monitoring has also been used in reference to post monitoring of implemented projects to see if they are still functioning as they were designed or intended (i.e., Action Agencies Implementation Plans and Updated Proposed Actions for the FCRPS BiOp).

Hierarchy of Information and Management Questions

Monitoring information is collected and analyzed at different scales in response to performance metrics and management questions at different hierarchical levels of detail. This hierarchy of information can be visualized as a pyramid with lower levels of information supporting higher levels of reporting and analyses (see Figure 1). PNAMP will coordinate information up and down this pyramid, as well as common information across programs within one level of the pyramid. The Strategy will include the identification of management questions and supporting monitoring information to be coordinated at these various levels of scale.

Figure 1. In the monitoring information pyramid, examples of types of information are on the left and related users or generators of that information are represented on the right.



PNAMP Coordination Structure and Monitoring Objectives

The following objectives for PNAMP coordination have been developed by the PNAMP Steering Committee and the various PNAMP workgroups. These objectives address key areas of regional coordination such as monitoring design and protocols, indicators and metrics, data standards, and project tracking. The design and implementation of these objectives and outcomes is expected to make monitoring efforts more effective, efficient, and meaningful.

Objective 1 Develop and Maintain a Monitoring Coordination Framework for the Pacific Northwest

The monitoring coordination framework should do the following:

- Provide policy support and direction by member organizations;
- Commit technical resources and staff time;
- Provide funding for desired levels of coordination; and

Provide higher-level focus and guidance for regional monitoring outcomes.

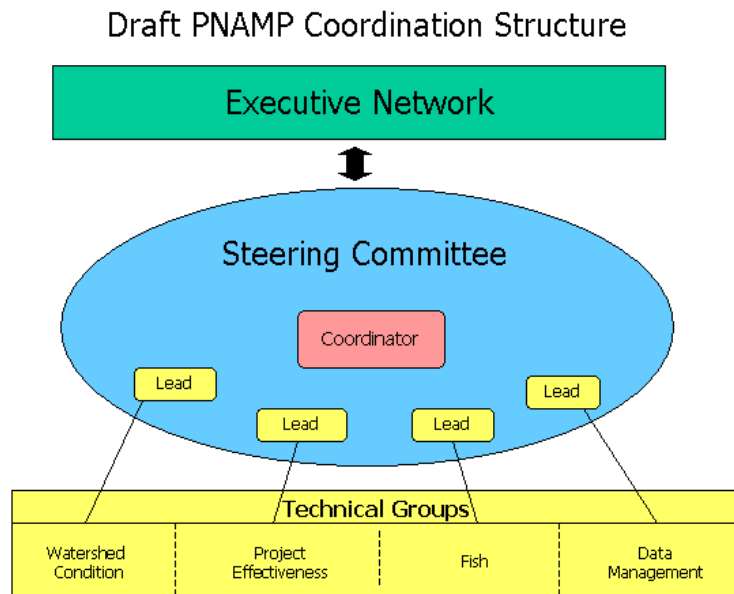
Outcome A Maintain an operating charter of agency-level signers that formally establishes PNAMP and formal operational practices, and provides guidance for technical participants.

Action Item 1 Maintain and update the PNAMP Charter as needed. The Charter includes principles, structure and participation, business practices, and reporting requirements. Figure 2 shows the draft Coordination Structure for the PNAMP.

Action Item 2 Develop a business practices document. The business practices document will describe the roles and duties of the various organizational levels of PNAMP and their associated decision making processes and communication mechanisms.

Action Item 3 Support the function of and interaction among PNAMP technical workgroups.

Figure 2. Draft Coordination Structure for the PNAMP.



Outcome B Identify high level management questions and their related hierarchical set of information needs shared by the participating agencies.

Action Item 1 Identify information needs and coordinate information sharing so that high level management questions may be answered by agencies in the region by aggregating monitoring and/or effectiveness research results across different spatial and/or temporal scales.

Outcome C Encourage the development of science-based monitoring strategies and designs to address key management questions.

Action Item 1 Coordinate scientific peer review of PNAMP technical products.

Outcome D Provide recommendations to regional executives and monitoring program leads.

Action Item 1 Provide coordinated programmatic approaches that integrate the strategic components of the watershed and fish monitoring, action effectiveness monitoring, and data management workgroups (and other technical workgroups as they are formed). These recommendations will provide guidance for common methodologies, compatible protocols, and partnership agreements needed for

regional monitoring programs to achieve the shared coordination objectives of the PNAMP membership agencies.

Outcome E Coordinate and recommend standardized sampling protocols and field data collection procedures between Status/Trend, Effectiveness, and Implementation Monitoring efforts.

Action Item 1 Provide opportunities for scientific discussion, comparison and sharing among the modules and regional experts to ensure that all participants are aware of the issues' consistencies and inconsistencies.

Action Item 2 Recommend a core set of indicators that can be shared among all types of monitoring to ensure desired consistency.

Outcome F Develop technical workgroups as needed for coordinating additional aspects of the Pacific Northwest aquatic environment.

Action Item 1 Provide a means to include other monitoring efforts in the PNAMP organization.

Action Item 2 Conduct a periodic needs assessment of other aquatic monitoring efforts that could benefit from PNAMP participation.

Action Item 3 Host meetings to facilitate the increased coordination of efforts that are not addressed in current work plans.

Action Item 4 The PNAMP Steering Committee members will assist in informing the Committee of opportunities for participation by other aquatic monitoring efforts that would benefit from improved coordination.

Outcome G Develop and implement pilot projects for testing monitoring actions.

Action Item 1 Support the Upper Columbia, John Day, and Upper Salmon Pilot Studies as testing areas for comparing protocols and sampling methods.

Objective 2 Coordinate Pacific Northwest Watershed Status/Trend Monitoring Efforts

Outcome A Identify the key questions that could be addressed with coordinated watershed level monitoring in support of management. Identify the

current and proposed metrics, monitoring designs, and evaluation methods that could be used to answer these questions.

The initial set of these questions includes the following:

1. What is the status of freshwater habitat within streams of the Pacific Northwest at a sub-basin and statewide scale? What are the trends?
2. What is the status of water quality in streams of the Pacific Northwest at a sub-basin and statewide scale? What are the trends?
3. What is the status of riparian condition (e.g., vegetation, seral state and number of roads) along streams of the Pacific Northwest at a sub-basin and statewide scale? What are the trends?
4. What is the status of upslope condition (e.g., vegetation, seral state, and number of roads) along streams of the Pacific Northwest at a sub-basin and statewide scale? What are the trends?

Outcome B Identify, develop and recommend a standardized set of metrics and compatible protocols for sampling designs and data collection.

- Action Item 1 Develop and recommend a regional aquatic monitoring design covering the states of Washington, Oregon, Idaho, and Northern California, using the EMAP probabilistic GRTS design developed by the EPA to ensure random, spatially balanced placement of sampling sites (Peck, et al. 2001).
- Action Item 2 Identify target confidence levels for detecting different levels of change in status indicators over time. Change over time will vary depending upon the variable measured and the environmental conditions. Although it would be preferable to have a higher level of certainty in establishing watershed condition, the size of the geographic area involved, variability in the indicator, and the overall costs of monitoring will determine the level of confidence that may be targeted.
- Action Item 3 Recommend a core set of attributes and protocols for state, federal, and tribal monitoring programs to use for collecting field data used in assessing status and trends in watershed condition.
- Action Item 4 Encourage pilot studies (field season tests) to resolve issues concerning conflicting protocols or attributes.
- Action Item 5 Verify and recommend regional performance benchmarks for each monitoring indicator or suite of indicators. Indicators in themselves do not provide a means for evaluating results. Performance targets or benchmarks are needed to give meaning to the results and provide a sound basis for adaptive management. Benchmarks allow us to identify limiting habitat conditions and track progress. In some

cases, such as the Clean Water Act, the targets are established by law.

Outcome C. Identify regional watershed monitoring efforts, including agency specific activities, that are key components of a monitoring network.

Action Item 1 Inventory existing watershed level monitoring efforts across the region.

Action Item 2 Develop and recommend standard reporting metrics for these monitoring projects.

Action Item 3 Develop a regional map with agencies identified geographically that are funding and implementing watershed condition monitoring. Identify common areas of interest where coordination efforts could result in cost efficiencies. Update annually.

Action Item 4 Develop a short list of indicators common to all regions that can be integrated to produce summarized reports suitable for describing regional progress to the public and to the highest levels of government.

Action Item 5 Facilitate a discussion towards the creation of a regional network of watershed monitoring activities.

Objective 3 Coordinate Pacific Northwest Instream Fish Population Monitoring Efforts

Outcome A Identify the key questions that could be addressed with coordinated fish population monitoring in support of management. Identify the current and proposed monitoring metrics, monitoring designs, and evaluation methods that could be used to answer these questions.

The initial set of these questions includes the following:

1. What are the overall abundances of adult salmonid populations within each ESU, sub-basin, and state? What are the trends?
2. What is the current distribution of adult salmonids within each sub-basin and state? What are the trends?
3. What is the freshwater productivity (e.g., smolt/female) of each population within the ESU, sub-basin, and state? What are the trends?

Outcome B Identify, develop and recommend a standardized set of metrics and compatible protocols for sampling designs and data collection.

- Action Item 1 Support and assist recent collaborative efforts of the Washington Department of Fish and Wildlife and the Wild Salmon Center with respect to resolving fish protocol issues and the standardization of methods used to count fish.
- Action Item 2 Recommend a coordinated approach to sampling juvenile and adult abundance in the region.
- Action Item 3 Encourage a more comprehensive approach to tagging and evaluating naturally produced juvenile migrants and adults in order to verify assumptions about data derived from hatchery origin coded wire tags.
- Action Item 4 Interact with the Collaborative System-wide Monitoring and Evaluation Project (CSMEP) for the Columbia River Basin in regards to its coverage of monitoring of fish populations, meeting protocols and performance metrics of interest to PNAMP, and addressing other action items listed under CSMEP objectives.

Outcome C Identify regional fish population monitoring efforts, including agency specific activities, that are key components of a monitoring network.

- Action Item 1 Inventory existing fish population monitoring efforts across the region.
- Action Item 2 Develop and recommend standard reporting metrics for these monitoring projects.
- Action Item 3 Develop a regional map with agencies identified geographically that are funding and implementing fish population monitoring. Identify common areas of interest where coordination efforts could result in cost efficiencies. Update annually
- Action Item 4 Develop a short list of indicators common to all regions that can be integrated to produce summarized reports suitable for describing regional progress to the public and to the highest levels of government.
- Action Item 5 Facilitate a discussion towards the creation of a regional network of fish population monitoring activities.

Objective 4 Coordinate Pacific Northwest Effectiveness Monitoring Efforts

With the listing of several West Coast salmon species as threatened or endangered under the federal Endangered Species Act (ESA), governors, numerous congressional and state legislators, and other leaders have sought to obtain funding to restore salmon populations and obtain economic relief for the region through recovery of species listed under the ESA. As a result, the fiscal investments made by state, federal, tribal and others involved in watershed health and salmon recovery are considerable. They range from small-scale habitat protection and restoration projects to large programs that manage land, water, or other resources within and across various jurisdictions and sectors. In nearly every case it is assumed that these programs and projects have the desired effect, but this assumption is rarely evaluated by project scale effectiveness monitoring, and even less so by complementary validation (cause-effect) monitoring. This section specifically addresses the need to understand the effectiveness of watershed health and salmon recovery investments in terms of their stated outcomes and the resulting effect on salmon populations, water quality, water quantity, and habitat.

PNAMP supports the development of a regional framework for determining which habitat projects are most effective. This Strategy addresses habitat project implementation monitoring, effectiveness monitoring, and the response of fish populations (validation monitoring) through intensively monitored watersheds. Habitat restoration projects typically have a “nested hierarchy” of objectives and results. The “nested hierarchy” also typically has associated monitoring at each level. For example, a riparian vegetation project might have the following series of outcomes and associated monitoring.

- Plant trees (Implementation monitoring)
 - Increase shading of stream (Effectiveness monitoring)
 - Reduce stream temperature (Effectiveness monitoring)
 - Increase salmon abundance (Validation monitoring)

The Strategy has addressed habitat project implementation monitoring, effectiveness monitoring, and the response of fish populations (validation monitoring) through intensively monitored watersheds.

Outcome A Identify the key questions that could be addressed by coordinated project effectiveness monitoring in support of management. Identify the current and proposed metrics, monitoring designs and evaluation methods needed to answer these questions.

The initial set of these questions includes:

1. What categories of restoration projects are most effective at the reach scale in terms of design longevity, habitat restoration, and local fish abundance?
2. What categories of restoration projects have demonstrated actual improvements in fish production within the watershed?
3. What is the location and functionality of fish passage barriers affecting listed species in the region? What are the trends?

4. What is the location and functionality of fish restoration projects throughout the region?

Outcome B Identify, develop and recommend a standardized set of metrics and compatible protocols for sampling designs and data collection.

- Action Item 1 Encourage monitoring reach scale habitat improvement effectiveness using a paired control/treatment experimental design in which a single type of habitat action is applied to a large number of sites (stream reaches) and compared to nearby, untreated control reaches.
- Action Item 2 Encourage funding entities to coordinate their investigations to reduce duplication and costs, and to obtain results in the shortest amount of time.

Outcome C Identify regional existing and planned habitat restoration projects and efforts, including agency specific activities, that are key components of a monitoring network.

- Action Item 1 Inventory existing habitat restoration projects across the region.
- Action Item 2 Develop and recommend standard reporting metrics for effectiveness monitoring.
- Action Item 3 Coordinate regional agreement on standard metrics for project level effectiveness monitoring studies of the PNAMP partners.
- Action Item 4 Coordinate regional agreement on standard data reporting and access formats for the metrics developed under Action Item 2.
- Action Item 5 Develop a regional map with agencies identified geographically that are funding and implementing effectiveness monitoring. Identify common areas of interest where coordination efforts could result in cost efficiencies. Update annually.
- Action Item 6 Develop a short list of indicators common to all regions that can be integrated to produce summarized reports suitable for describing regional progress to the public and to the highest levels of government.
- Action Item 7 Facilitate a discussion towards the creation of a regional network of effectiveness monitoring activities.

Outcome E Develop a recommended network of Intensively Monitored watersheds (IMW) and reach specific studies for effectiveness monitoring.

Intensively monitored watersheds are designed to address key questions in a disciplined scientific manner. All possible factors need to be considered: accurate measures of fish populations including spawners entering the watershed and juvenile migrants leaving the watershed, and accurate estimates of mortality factors such as marine conditions, harvest, hydropower, predation, and other factors directly affecting salmon abundance and survival. Without a holistic approach, it will not be possible to determine the response of salmon to habitat restoration and other management efforts.

Action Item 1 Recommend a strategy for placing IMWs throughout the Pacific Northwest to monitor and evaluate “cause and effect” relationships between habitat restoration and management actions, and changes in fish population responses and other viable salmonids population criteria.

Action Item 2 Develop a regional map with agencies identified geographically that will be responsible for funding and implementing intensively monitored watershed monitoring. The IMWs should be coordinated to reflect differing ecoregions, species, and treatments. Selection of IMWs should be a cooperative process between federal and State agencies, and local watersheds.

Action Item 3 To reduce the risk of not being able to detect a change resulting from habitat projects, PNAMP will encourage federal and state governments that select and fund habitat restoration projects to cluster them in the identified intensively monitored watersheds so that the amount of habitat improved can be at a scale measurable in terms of migrant salmonids produced.

Objective 5 Coordinate Pacific Northwest Data Management Efforts

Adequate access to high quality monitoring data, analyzed information, and reports is a critical, and as yet, unmet need for many partners working to restore our watersheds and salmon populations. The US Congress, the Northwest Power and Conservation Council, and others have identified access and quality of information as a gap and a primary focus point.

The overall PNAMP data management goal is to assist scientists in the identification and development of data standards as it relates to the monitoring of fish and aquatic habitat.

This Objective helps to identify solutions that improve access, sharing, and coordination among different collectors and users of fish and aquatic habitat monitoring data. It provides a data reporting foundation that would lead towards coordinated agency reporting, uniform monitoring protocols, and improved data quality and quantity.

Outcome A Develop a consistent data management methodology within and across each of the PNAMP Workgroups.

Provide leadership and coordination between the various workgroups. Establish similar approaches to information management across the various PNAMP workgroups to ensure consistency.

Action Item 1 Recommend a common data management methodology for use within and across each PNAMP workgroup.

Action Item 2 Develop a detailed PNAMP Data Management Coordination Plan that follows the methodology and sets out a time frame for deliverables.

Outcome B. Establish a close working relationship for data consistency across the Workgroups.

Provide consistent communication of information management approaches across all PNAMP Workgroups.

Action Item 1 Develop and share materials, plans and solutions across the work groups and develop common solutions to common data problems.

Outcome C Identify and document the specific data needs of the PNAMP for Watershed Condition Monitoring, Fish Population Monitoring, and Effectiveness Monitoring Workgroups, and other technical workgroups as they are formed.

Action Item 1 Assist each technical workgroup to assess and identify their business information needs in order to support each work group's requirements.

Action Item 2 Document the metrics, sampling designs, and data collection protocols that will be used.

Action Item 3 Assess needs and gather user requirements and preferences.

Outcome D Develop and recommend data collection standards and information to be shared across the various monitoring programs.

Validate that data standards are consistent and compliant to the maximum extent possible with any state, regional or national requirements for data collection and management. Document all agreed upon standards and procedures.

Action Item 1 Leverage existing data collection/reporting standards by engaging in collaborative activities with other data standardization efforts, for example, FGDC, the State Federal Framework effort, the OR/WA Hydrology clearinghouses, Federal PNW Information Coordinating Council (previously IRRIC), NED, and possibly others.

Action Item 2 Interact with NED, IRICC and other regional data entities to ensure that PNAMP monitoring data collection and management complies to the maximum extent possible, with National, State or regional data collection and management standards.

Action Item 3 Review data issues, such as the following:

- Link data collected at the sampling reach with PNW Hydro Clearinghouse data or the best available hydrography layer.
- Identify a list of needed GIS layers needed by region, sub-basins, and ESU's, and ensure that GIS data has FGDC compliant metadata
- Develop needs regarding monitoring data, including; storage of raw data, data sharing standards and metrics, and access and work with Northwest Environmental Data Network (NED), to identify networking solutions.

Outcome E Share PNAMP requirements and results with regional data networking entities to ensure sharing of monitoring data.

Promote a systematic approach to meeting regional data needs through more consistent use of database designs, data protocols, data dictionaries, and data sharing, among PNW participants.

Action Item 1 Interact with and support existing data coordination efforts, for example the NED and the Federal PNW Information Coordinating Council (previously IRICC) and others.

Outcome F Test the collection protocols, sampling methods and data sharing mechanisms.

Develop and use verification and testing procedures of PNAMP standards to validate that they work.

Action Item 1 Support the use of the FCRPS pilot efforts in the John Day, Upper Columbia and Salmon Rivers and in the Columbia Estuary and the State Intensively Monitored Watershed efforts to test PNAMP solutions.

Outcome G Implement coordinated solutions within PNAMP members programs.

Recommend and work to include final workgroup standards into each PNAMP partner organization's information management business operations.

Action Item 1 Interact with regional data programs to provide outreach, education and training to support the use of PNAMP data protocols and standards.

Action Item 2 Advocate that PNAMP monitoring data is collected and shared using PNAMP data protocols and standards.

Action Item 3 Maintain, test, update and correct data collection standards as needed throughout the life of the PNAMP coordination effort.

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- [Although this draft document states that it should not be cited or quoted, some of the material in the report is an important improvement to Lazorchak et al. (1998). By not citing the document, it may give the appearance that this document improves some of the methods outlined in the Lazorchak et al. report. To avoid this, PNAMP believes it is necessary to offer credit where credit is due.]*
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Appendix A Entities Signatory to the PNAMP Charter

Bonneville Power Administration
California Department of Fish and Game
Columbia Basin Fish and Wildlife Authority
Columbia River Intertribal Fish Commission
Confederated Tribes of the Colville Reservation
National Oceanic and Atmospheric Administration Fisheries
Northwest Indian Fisheries Commission
Northwest Power and Conservation Council
Oregon Watershed Enhancement Board (also representing ODFW, ODEQ, ODF)
Pacific States Marine Fisheries Commission
US Bureau of Land Management
US Bureau of Reclamation
US Environmental Protection Agency
US Forest Service
US Geological Survey
Washington Department of Ecology
Washington Governor's Salmon Recovery Office
Washington Interagency Committee for Outdoor Recreation/ Salmon Recovery Funding Board